Surface Conditioning and Bonding Protocol for Polymer-infiltrated Ceramic: How and Why?

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Surface Conditioning and Bonding Protocol for Polymer-infiltrated Ceramic: How and Why?

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IAAD WORKING INSTRUCTIONS

Question: What is the best surface conditioning and bonding protocol for indirect restorations manufactured from polymer-infiltrated ceramic-based CAD/CAM blocks?

Answer: Polymer-infiltrated ceramic network (PICN) material has been introduced for use in conjunction with CAD/CAM technologies in dentistry. The PICN structures are claimed to present flexural strength, elasticity modulus, and hardness values similar to those of the natural tooth.[1,4,13] In addition, they are less brittle than ceramic materials, allowing excellent machinability and edge stability during milling.[12] Due to their favorable mechanical strength, such materials could be indicated from minimal[2] to moderate-size restorations.[4] PICN blocks consist of interpenetrating networks of ceramic and polymer, with an aluminum oxide-enriched, fine-structured feldspar matrix (86 wt%) into which 14 wt% urethane dimethacrylate and triethylene glycol dimethacrylate polymer material is injected.[3] For the adhesive cementation of restorations made of these materials, limited published material is available apart from the manufacturer's instructions. Thus, the following surface conditioning and bonding protocol could be recommended based on the available scientific reports:

Do	Why?
After clinical try-in, adjusting and polishing, indirect PICN restorations should be ultrasonically cleaned in distilled water for at least 5 min and dried with oil-free air.	Cleaning saliva proteins and other contaminants from the cementation surface helps ensure adequate adhesion of the subsequent adhesive promoters to be applied on the surface.[2]
Etch the intaglio surface of the restoration with 5% hydrofluoric acid (HF) for 60 s. Remove etching gel using water spray for 60 s, clean the surface with alcohol (96%) and dry for 20 s. After drying, the etched surfaces should exhibit a whitish opaque appearance.	After etching with HF, the PICN topography is characterized by the exposure of the resin network, while the ceramic matrix is selectively removed.[10] This is because a major leucite-based phase of feldspar origin is present in the ceramic matrix of the PICN.[5]
Apply a thin coat of silane coupling agent with a clean brush on the intaglio surfaces of the restorations without agitation and allow it to react 60 s. Then, dry with a strong stream of oil-free air. Although not always recommended by the manufacturer, it is advisable to also apply a bonding agent to the restoration's cementation side; this should not be light cured.	PICN material exhibited the best bonding performance when etched with HF and silanized.[9] The methoxy groups of silane-containing primer chemically bonds with both the SiO_2 and integrated polymer components of the PICN, polymerizing with the methacrylate groups of the resin composite available in the matrix.[8] Additional application of a bonding agent results in a better infiltration of resin within the produced etch pits; this layer should not be cured in order not to harm the restoration's fit.
Apply the adhesive resin on the cementation surface following the manufacturer's instructions. Carefully air thin the adhesive resin on the dentin with oil-free air and photopolymerize it for the duration recommended by the manufacturer.[12]	Immediate and separate photopolymerization of the adhesive resin on the dentin surface stabilizes the hybrid layer, preventing rapid water uptake from the dentin; it increases the bond strength of resin luting cements.[12]
Apply dual- or photopolymerizing resin-based luting cement to the intaglio surface and position the restoration on the previously conditioned preparation. Remove the excess cement, maintaining the restoration in place.	The manufacturer of PICN indicates the use self-adhesive resin cements for crowns. It must be noted that degree of conversion of self-adhesive resin cements is lower than dual polymerizing ones.[14] Indirect restorations 3 mm thick or more should still be cemented with dual-polymerizing cements.
Photopolymerize for 60 s from each direction to ensure optimal polymerization.	For thin veneers, photopolymerizing resin cement should be preferred, as dual-polymerizing ones may show slight color change after polymerization.[11]
Check the premature contacts, eliminate them carefully, finish and re-polish the restoration.	Since PICN contains two phases, ie, the ceramic and the resin, presenting different levels of surface lusture, the resin component should be as well polished as the ceramic component.

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CAVE: Currently, the most commonly used polymer-infiltrated ceramic-network (PICN) material is VITA Enamic (VITA Zahnfabrik; Bad Säckingen, Germany). Other, similar products could be introduced for dental reconstructions in the near future. This protocol is a combination of the manufacturer's instructions and the results of available literature. Clinicians should study the composition of such products and make sure that the main component is ceramic including some resin when they employ the above-mentioned protocol. Both the manufacturer and the available studies favor HF etching and silanization as a conditioning method prior to adhesive cementation or repair. The etching duration and subsequent cleaning protocol given here is according to the manufacturer's instructions only. Clinicians should also note that the available literature did not focus on aging of adhesive interfaces between resin cements and the PICN material.

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